

## **FILE B**

### **Science and Technology:**

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# **Science and Technology**

**Item Information and Scoring Guide Reference Sheet  
and Quantities of Items by Type**

# Item Information and Scoring Guide Reference Sheet

The following pages are designed to assist you in understanding how Maine Educational Assessment (MEA) items are scored. These pages contain the text for each item accompanied by the following information.

- **MC#:** the multiple-choice item position
- **Key:** the letter of the correct answer for the multiple-choice item
- **Learning Results:** the content standard, followed by the performance indicator, that the item measured
- **SA#:** the short-answer item position
- **Learning Results:** the content standard, followed by the performance indicator, that the item measured
- **Short-Answer Scoring Guide:** the two-point description used to determine the score
- **Training Notes:** in-depth descriptions or particular information used to determine the score
- **CR#:** the constructed-response item position
- **Learning Results:** the content standard, followed by the performance indicator, that the item measured
- **Constructed-Response Scoring Guide:** the four-point description used to determine the score
- **Training Notes:** in-depth descriptions or particular information used to determine the score

## **MAINE 2001–2002**

### **Science and Technology Grade 11**

The table below shows the quantities of released items for each item type. Item information for all item types and scoring information (guides and training notes) for all short-answer and constructed-response items follow.

#### **QUANTITIES OF ITEMS BY TYPE**

<b>MC</b>	<b>SA</b>	<b>CR</b>
20	5	5

**Items with Keys, Learning Results, Scoring Guides,  
Training Notes, and Student Responses**

1. If there were a significant decrease in the amount of ozone in the atmosphere, which health condition would likely increase?
  - A. brain tumors
  - B. skin cancer
  - C. ulcers
  - D. flu

**MC#: 1**

**Key: B**

**Learning Results: F-2**

The Earth

F Students will gain knowledge about the earth and the processes that change it. Students will be able to  
2 analyze potential effects of changes in the earth's oceans and atmosphere.

2. Which statement is true of reproduction for both humans and frogs?
- A. The egg cells are about the same size as the sperm cells.
  - B. The egg and sperm cells unite inside adult females.
  - C. Males produce many sperm cells.
  - D. Females produce one egg a month.

**MC#: 2**

**Key: C**

**Learning Results: D-5**

Continuity and Change

- D Students will understand the basis for all life and that all living things change over time. Students will be able to
- 5 compare and contrast fertilization, zygote formation, and embryo development in humans and other species.

3. Which advantage does the Hubble Space Telescope have over the best land-based telescope?

- A. detail of image
- B. cost of operation
- C. size of lens
- D. ease of repair

**MC#: 3**

**Key: A**

**Learning Results: G-1**

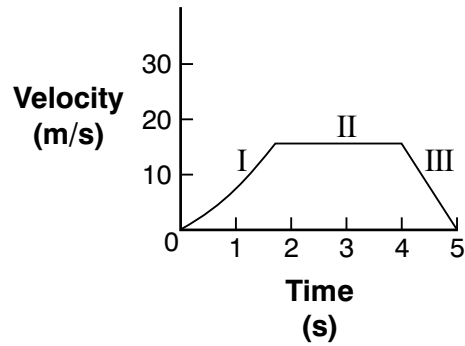
The Universe

G Students will gain knowledge about the universe and how humans have learned about it, and about the principles upon which it operates. Students will be able to

1 describe how scientists gather data about the universe.



Newton's second law states that a net force acting on an object causes the object to accelerate in the direction of the force. Acceleration is the rate of change of velocity.



4. During which interval was a net force acting on the object?
- A. interval I only
  - B. interval II only
  - C. intervals I and II only
  - D. intervals I and III only

**MC#: 4**

**Key: D**

**Learning Results: L-4**

Communication

L Students will communicate effectively in the application of science and technology. Students will be able to  
4 employ graphs, tables, and maps in making arguments and drawing conclusions.

	<b>Carbon-14 Source beta radiation (counts per minute)</b>	<b>Cesium-137 Source beta and gamma radiation (counts per minute)</b>
no protection	1279	1458
aluminum shield	407	1325
cotton fabric shield	1050	1439
glass shield	357	1299
plastic shield	1159	1449

5. Which material listed in the table appears to give the **most** protection from radiation?

- A. aluminum
- B. cotton fabric
- C. glass
- D. plastic

**MC#: 5**

**Key: C**

**Learning Results: L-4**

Communication

L Students will communicate effectively in the application of science and technology. Students will be able to  
4 employ graphs, tables, and maps in making arguments and drawing conclusions.

1 H 1.008	Periodic Chart of the Elements																2 He 4.003
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.70	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (97)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.30
55 Cs 132.91	56 Ba 137.33	57 *La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.37	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.03	89 **Ac (227)	104 Unq (261)	105 Unp (262)	106 Unh (263)	107 Uns (262)											

6. Which gas is the **least** chemically reactive?

- A. hydrogen
- B. nitrogen
- C. neon
- D. chlorine

MC#: 6

Key: C

Learning Results: E-6

Structure of Matter

E Students will understand the structure of matter and the changes it can undergo. Students will be able to  
6 compare the physical and chemical characteristics of elements.

7. If scientists wish to know whether two organisms are closely related, which molecules from each organism would they analyze for similarities?
- A. fats
  - B. proteins
  - C. starches
  - D. sugars

**MC#: 7**

**Key: B**

**Learning Results: A-1**

Classifying Life Forms

- A Students will understand that there are similarities within the diversity of all living things. Students will be able to
- 1 explain the role of DNA in resolving questions of relationship and evolutionary change.

8. During an experiment, a scientist used petri dishes, nutrient agar, stains, and a light microscope. The scientist was **most likely** studying
- A. bacteria.
  - B. amoebas.
  - C. earthworms.
  - D. viruses.

**MC#: 8**

**Key: A**

**Learning Results: J-1**

Inquiry and Problem Solving

- J Students will apply inquiry and problem-solving approaches in science and technology. Students will be able to
- 1 make accurate observations using appropriate tools and units of measure.

9. Light-years are usually used as the unit of measure for the distance between Earth and
- A. the Moon.
  - B. the Sun.
  - C. a comet.
  - D. a nebula.

**MC#: 9**

**Key: D**

**Learning Results: G-3**

The Universe

- G Students will gain knowledge about the universe and how humans have learned about it, and about the principles upon which it operates. Students will be able to
- 3 explain how astronomers measure interstellar distances.

10. If a rigid sealed container of gas is heated, can a prediction be made as to what will happen to its pressure?
- A. Yes, the pressure decreases.
  - B. Yes, the pressure remains the same.
  - C. Yes, the pressure increases.
  - D. No, there is not enough information given.

**MC#: 10**

**Key: C**

**Learning Results: E-2**

Structure of Matter

E Students will understand the structure of matter and the changes it can undergo. Students will be able to  
2 analyze how matter is affected by changes in temperature, pressure, and volume.

A student investigated the respiratory requirements of yeast cells. She set up four beakers with the contents shown in the table.

Beaker	Contents
A	10 mL yeast suspension 10 mL glucose solution 10 mL distilled water
B	10 mL yeast suspension 10 mL glucose solution 10 mL magnesium sulfate
C	10 mL yeast suspension 20 mL distilled water
D	10 mL yeast suspension 10 mL glucose solution 10 mL sodium fluoride solution

11. Which beaker was the control or standard for comparing the experimental effects in this investigation?

- A. Beaker A
- B. Beaker B
- C. Beaker C
- D. Beaker D

**MC#: 11**

**Key: C**

**Learning Results: J-3**

Inquiry and Problem Solving

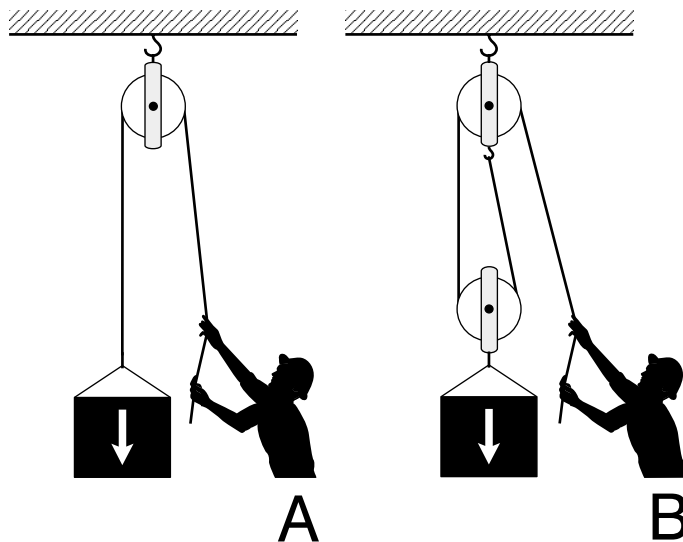
- J Students will apply inquiry and problem-solving approaches in science and technology. Students will be able to
- 3 demonstrate the ability to use scientific inquiry and technological method with short-term and long-term investigations, recognizing that there is more than one way to solve a problem. Demonstrate knowledge of when to try different strategies.



$$\text{Work} = \text{Force} \times \text{distance}$$

or

$$W = Fd$$



12. To lift the block 5 m, which person applies more force and by how much?
- A. person A, by twice as much
  - B. person B, by twice as much
  - C. person A, by four times as much
  - D. person B, by four times as much

**MC#: 12**

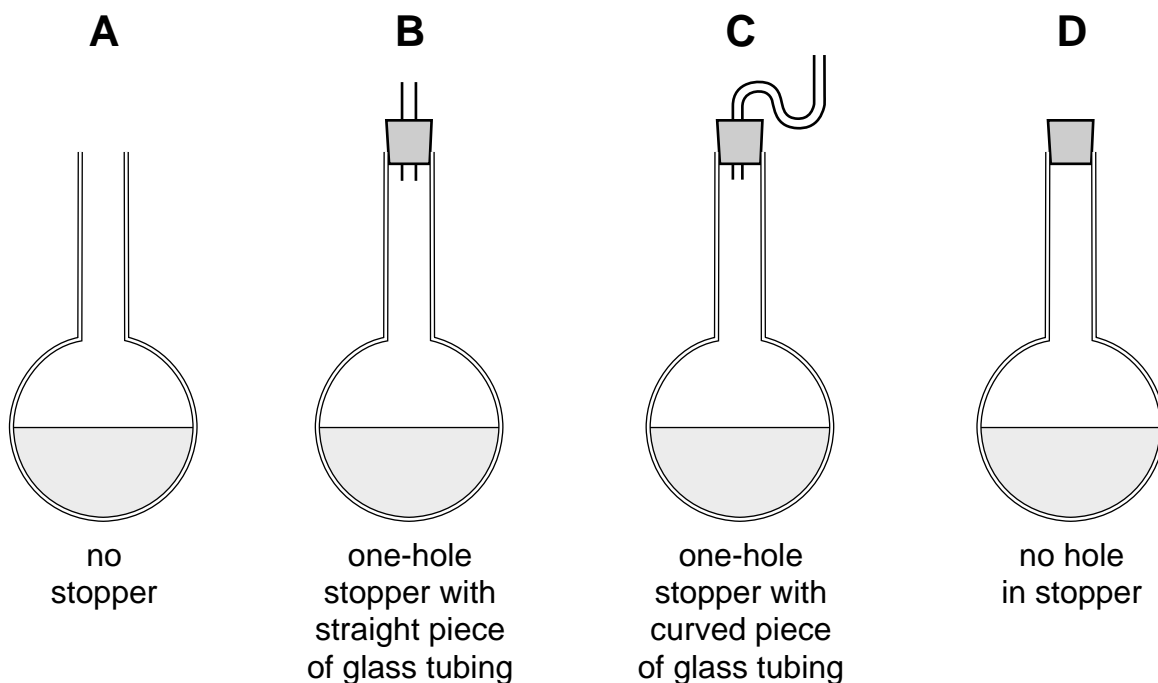
**Key: A**

**Learning Results: H-5**

Energy

H Students will understand concepts of energy. Students will be able to  
5 use mathematics to describe the work and power in a system.

In the 1500s many people believed in spontaneous generation, the idea that living things can arise from nonliving things. Suppose a person who believed in spontaneous generation conducted an experiment to collect evidence to support this idea. The person took four flasks, placed 50 mL of nutrient broth in each flask, and then sterilized the flasks and broth. The stoppers on the four flasks were varied. After three days, the person analyzed the contents of the flasks.



13. The presence of microorganisms in which flask would **best** demonstrate that spontaneous generation had occurred?
- A. flask A
  - B. flask B
  - C. flask C
  - D. flask D

**MC#:** 13

**Key:** D

**Learning Results:** J-2

Inquiry and Problem Solving

- J Students will apply inquiry and problem-solving approaches in science and technology. Students will be able to
- 2 verify, evaluate, and use results in a purposeful way. This includes analyzing and interpreting data, making predictions based on observed patterns, testing solutions against the original problem conditions, and formulating additional questions.

14. Earth crustal movements are caused by convection currents in the mantle. Which theory best explains the changing face of Earth?

- A. evolution
- B. plate tectonics
- C. big bang
- D. relativity

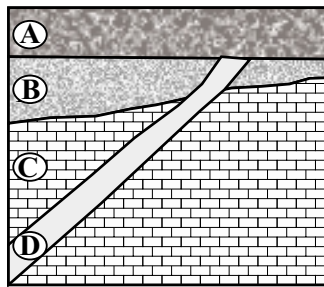
**MC#: 14**

**Key: B**

**Learning Results: F-3**

The Earth

F Students will gain knowledge about the earth and the processes that change it. Students will be able to  
3 describe the impact of plate movement and erosion on the rock cycle.



15. Which layer of rock is the oldest?

- A. layer A
- B. layer B
- C. layer C
- D. layer D

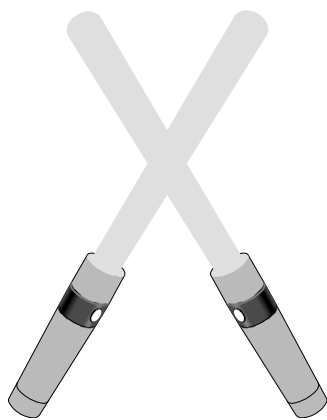
**MC#:** 15

**Key:** C

**Learning Results:** F-5

The Earth

F Students will gain knowledge about the earth and the processes that change it. Students will be able to  
5 demonstrate how rocks and minerals are used to determine geologic history.



16. This diagram shows that the beams of light from two flashlights can pass through each other and then continue on unaffected. This observation illustrates which property or properties of light?
- A. only particle
  - B. only wave
  - C. both particle and wave
  - D. neither particle nor wave

**MC#:** 16

**Key:** B

**Learning Results:** H-1

Energy

H Students will understand concepts of energy. Students will be able to  
1 analyze the evidence that leads scientists to conclude that light behaves somewhat like a wave and somewhat like a particle.

Planaria are black flatworms that live in water. When exposed to light, they swim away from it.

17. State and explain a possible adaptive function for this behavior of Planaria.

**SA#: 17**

**Learning Results: K-6**

Scientific Reasoning

K Students will learn to formulate and justify ideas and to make informed decisions. Students will be able to  
6 analyze situations where more than one logical conclusion can be drawn.

#### SHORT-ANSWER SCORING GUIDE

Score	Description
2	Response states and explains a possible adaptive function of this behavior of Planaria.
1	Response states a possible adaptive function.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

#### Training Notes for Short-Answer #17

2 points

to hide from predators because black is easy to see in the light

OR

to escape from the light because light is harmful to Planaria (like UV is to humans)  
their prey live in the dark

1 point

to hide from predators

to hide

to escape from the light (they don't like light)

to escape

17.

2

The light will expose them to the predators that want to eat them

17.

2

The Planaria hide from light because they need darkness to hide from any predators

17.

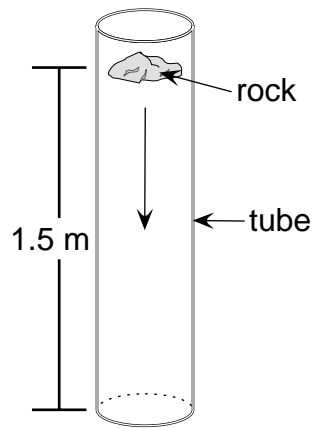
1

Planaria, the black flatworms, swim away from light when exposed because their adaptive function is not to be seen.

17.

1

Planaria have adapted to stay away from light because they need darkness to survive.



Inside this vertical tube is a vacuum. A rock is dropped from the top of the tube. The table shows what the potential energy and kinetic energy of the rock are at various heights.

Height (meters)	Potential Energy (joules)	Kinetic Energy (joules)
1.5	10.3	0
1.2	8.2	2.1
0.8	5.5	4.8
0.4	2.7	7.6

18. Describe the relationship between the potential energy and the kinetic energy of the rock.

**SA#: 18**

**Learning Results: K-3**

Scientific Reasoning

K Students will learn to formulate and justify ideas and to make informed decisions. Students will be able to  
 3 develop generalizations based on observations.



## SHORT-ANSWER SCORING GUIDE

Score	Description
2	Response states a quantitative relationship between the potential and kinetic energy of the rock falling in a vacuum.
1	Response states a relationship between the potential and kinetic energy, but only in qualitative terms.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

### Training Notes for Short-Answer #18

2 points

The sum of the potential and kinetic energies is a constant.

OR

The amount of potential energy lost is the same as the amount of kinetic energy gained.

1 point

As potential energy decreases, kinetic energy increases.

OR

The potential energy decreases and the kinetic energy increases.

18.

The PE is exchanged for KE as the rock falls. The remaining PE plus the KE is equal to the original PE, due to conservation of energy.

2

18.

The potential energy is changed to kinetic energy as the rock falls but together it always equals 10.3J because no energy is lost to air resistance

2

18.

The relationship between the potential and kinetic energies is that as the potential energy decreases the kinetic energy increases.

1

18.

As the potential energy drops the kinetic energy increases.

1

Substances	Normal Levels (in parts per million at 20°C)	Indication of Pollution
oxygen	9.0	Low level suggests sewage pollution.
calcium and magnesium	60.0	High level suggests industrial pollution.
nitrogen (nitrates and ammonia)	0.20	High level suggests sewage or farm runoff pollution.
phosphorus (phosphates)	0.01	High level suggests sewage or farm runoff pollution.

19. A sample from a river was analyzed and found to have the following amounts of each of these substances.

oxygen	9.2 ppm
calcium and magnesium	58.9 ppm
nitrogen	0.21 ppm
phosphorus	0.01 ppm

- What conclusion can be drawn about whether this water sample is polluted?
- Explain your answer to part a.

**SA#: 19**

**Learning Results:**L-4

Communication

- L Students will communicate effectively in the application of science and technology. Students will be able to
- 4 employ graphs, tables, and maps in making arguments and drawing conclusions.

## SHORT-ANSWER SCORING GUIDE

Score	Description
2	Response states the water is not polluted and indicates that the parts per million do not deviate much from the typical values.
1	Response simply states the water is not polluted.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

### Training Notes for Short-Answer #19

2 points

the sample is not polluted, the parts per million do not differ much from normal

1 point

the sample is not polluted

19.

2

a. The water is not polluted.

B. The water is not polluted because the substance levels are normal.

19.

2

a.) The sample suggests the water isn't polluted.

b.) Most of the ppm values are normal, and none match the pollution indicators.

19.

1

This sample would be considered not to be polluted. That being because you need those substances.

19.

1

This river probably isn't polluted because there is only a minut difference and no two rivers are the same

20. Give **two** ways the concentration of salt in the ocean can decrease.

**SA#:** 20

**Learning Results:** F-2

The Earth

F Students will gain knowledge about the earth and the processes that change it. Students will be able to  
2 analyze potential effects of changes in the earth's oceans and atmosphere.

#### SHORT-ANSWER SCORING GUIDE

Score	Description
2	Response includes two ways the salinity of an ocean can decrease.
1	Response includes one way the salinity of an ocean can decrease.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

#### Training Notes for Short-Answer #20

1. rainfall
2. addition of fresh water from rivers
3. addition of fresh water from melting glaciers

20.

2

<sup>a)</sup>If all fresh water flowed into the oceans and <sup>b)</sup>if the Polar Ice Caps melt.

20.

2

Two ways salt concentration can decrease in the ocean are a significant amount of Rain fall or when a River or stream flows into it.

20.

1

The ocean's temperature will increase and fresh water is added to the ocean.

20.

1

If We had a warm winter with alot of rain, it would delete the salt.

21. An object is traveling 3 m/s west. If there were absolutely no forces acting on this object, describe its motion during the next two seconds.

**SA#: 21**

**Learning Results: I-3**

Motion

- 1 Students will understand the motion of objects and how forces can change that motion. Students will be able to
- 3 use Newton's laws to qualitatively and quantitatively describe the motion of objects.

### SHORT-ANSWER SCORING GUIDE

Score	Description
2	Response is "travels 3 m/s west" or "travels 6 m west" or "does not accelerate."
1	One (and only one) of the following is incorrect or missing: the number, the units, or the direction.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

### Training Notes for Short-Answer #21

travels 3 m/s west (or)  
travels 6 m west (or)  
does not accelerate (or)  
continues in same direction at same speed



21.

2

It would be going 5 m/s west if no forces were acting on it.

21.

2

The object would continue in the same direction at the same speed for the next two seconds.

21.

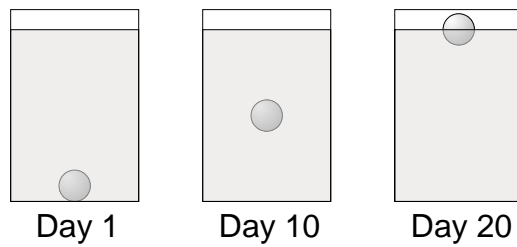
1

This object with no forces acting upon it would stay in motion without acceleration. It would maintain a constant speed and would gain another six meters while doing so.

21.

1

An object traveling 3 m/s west with absolutely no forces acting on it, would continue to go in that direction.



22. A student places some table salt into a cylinder of water and drops an object into the cylinder. It sinks. After 20 days the student observes that the object is floating.
- Give a hypothesis that explains this change.
  - Design an experiment to test the hypothesis. Include a description of the procedure you would use and what data you would collect. Explain how the data would help you decide if the hypothesis is correct or not.

**CR#: 22**

**Learning Results: K-1**

Scientific Reasoning

- K Students will learn to formulate and justify ideas and to make informed decisions. Students will be able to
- 1 judge the accuracy of alternative explanations by identifying the evidence necessary to support them.

## CONSTRUCTED-RESPONSE SCORING GUIDE

Score	Description
4	Response demonstrates comprehensive ability to explain a phenomenon and identify evidence to support the explanation. Response includes a fully developed hypothesis and experiment, including a description of procedure/data collection and explanation of how the data would help student decide if the hypothesis is correct or not. Response contains no errors or omissions.
3	Response demonstrates general ability to explain a phenomenon and identify evidence to support the explanation. Response includes an adequate hypothesis and experiment, including a description of procedure/data collection and how the data would help student decide if the hypothesis is correct or not. Response contains minor errors or omissions.
2	Response demonstrates limited ability to explain a phenomenon and identify evidence to support the explanation. Response includes a simplistic hypothesis and experiment. Response contains major errors or omissions.
1	Response demonstrates little ability to explain a phenomenon and identify evidence to support the explanation. Response includes a minimal hypothesis and/or experiment.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

### Training Notes for Constructed-Response #22

This question is better scored holistically than by points. The points indicated below are only given as rough guidelines. Scores arrived at by points must match the descriptions in the above rubric. If they don't, the rubric has precedence.

Possible Hypotheses: (1 point)

1. Water evaporated, concentrating the solution and increasing the density of it so that the object (that is nearly the same density as water) now floats.
2. Someone came along and stirred the solution when no one else was there. This put more salt into the water, making the solution denser and thus the object (nearly the same density as water) now floats.
3. The salt took time to dissolve. This put more salt into the water, making the solution denser and thus the object (nearly the same density as water) now floats.
4. The temperature of the system on the day the object was observed floating was much less than the first day. Since water is denser at lower temperature, the object now floats.

Note: Hypothesis does not need to be scientifically accurate, only plausible to a high school student.

Procedure/Data Collection (2 points)

may include control of variables and/or multiple trials, fair test of hypothesis

Explanation of how the data would help decide if hypothesis is correct or not. (1 point)

22.

4

a. An hypothesis to why the ball is floating could be that over the days the table salt or NaCl slowly dissolves into the water. This would cause the density of the water to increase causing the density of the ball or object placed into the cylinder to become less than the water/NaCl. This would enable the ball to float. b. Procedure: In doing this experiment I would begin by determining the density of a cylinder of plain water. (Density = Mass/Volume). Next I would determine the density of water with table salt dissolved in it. Next I would place an object in the  $H_2O$  and then I would place the same exact object into the  $H_2O + NaCl$ . I would record whether the object would float or sink. I would repeat this experiment three or four times to make sure there are no discrepancies. If the ball floated in the cylinder with  $H_2O$  and NaCl and sunk in the cylinder of  $H_2O$ , then I would know that my hypothesis was correct.

Ⓐ The evaporation of the water causes the water to have increased density due to the salt, and then causes the object to float.

- Ⓑ Procedure:
1. Fill 2 beakers with water
  2. Add table salt to one beaker. 3tbl spoon
  3. Place objects in beakers
  4. Every day record water level and where object sits in relation to bottom

In the experiment, the control would change only in water level, showing water evaporated. In the test beaker the ball would rise <sup>also</sup> showing that the density of salt water had increased due to a higher concentration of salt.

Hypothesis: As the salt dissolved into the water it become more dense thus the ball could float easier as the salt dissolved more every day.

To test this hypothesis I would use two cylinders of water. One would contain salt. This would be my experimental setup. The other cylinder would contain plain water. This would be the control setup. I would then add a ball to each cylinder and wait twenty days. If the ball in plain water was still at the bottom and the ball in salt water is at the top I would know my hypothesis is correct. If both balls are still at the bottom or if both are at the top I would know my hypothesis is incorrect.

Ⓐ It sounds as if the table salt was not stirred up to dissolve in the water and the object sank. After 20 days perhaps the salt (just sitting there) finally dissolved and since salt in water helps things to float the object rose to the surface.

Ⓑ First I would have 3 cylinders full with water and 3 objects all the same. In the first cylinder I would place no salt, in the second and third I would put salt. In the second cylinder I would stir up the salt slightly and fully in the third. Then place the objects in each. I would make a table with cylinders A, B and C, and record what happened to the object I put in. This would prove or disprove my hypothesis.

a. When there was fresh water with a little salt in it, the object was more dense than the water. As the salt dissolved, it became more dense than the object.

b. Take a cup of salt water that is completely dissolved, and a cup of fresh water. Drop the object into each and see if it floats.

My hypothesis is that as the salt slowly dissolved the object became more buoyant.

To test this I would recreate this experiment and have a cylinder of unsalted water with the object in it. This cylinder would be used as a constant. If the object in the fresh water did not float in 20 days and the salt water did I would know that the salt effected the experiment.



22. the salt dissolved slowly in the water, causing it to become, slowly, more buoyant. 1

Put varying amounts of salt into beakers and note the effect of the object.

22. a) The salt had dissolved. 1

b) You would put more than one object in and double the amount of salt and then wait some amount of days.

23. For each of the following cells, explain one way the indicated structure helps the cell carry out its specific function.
- leaf cell – chloroplast
  - skeletal muscle cell – mitochondrion
  - red blood cell – cell membrane
  - white blood cell – lysosome

**CR#: 23**

**Learning Results: C-1**

Cells

- C Students will understand that cells are the basic units of life. Students will be able to  
1 relate the parts of a cell to its function.

### CONSTRUCTED-RESPONSE SCORING GUIDE

Score	Description
4	Student demonstrates thorough knowledge of the function of cell parts. Response explains how all four structures help the specified cells carry out their functions. Response contains no errors.
3	Student demonstrates general knowledge of the function of cell parts. Response explains how at least three of the structures help the specified cells carry out their functions. Response contains minor errors or omissions.
2	Student demonstrates partial knowledge of the function of cell parts. Response explains how at least two of the structures help the specified cells carry out their functions. Response contains major errors or omissions.
1	Student demonstrates little knowledge of the function of cell parts. Response explains how one of the structures helps the specified cell carry out its function. Response is minimal.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

### Training Notes for Constructed-Response #23

(1 point each)

Chloroplasts is where photosynthesis occurs.

Mitochondria produce the energy skeletal muscle cells need for movement.

Cell membrane allows gases in and out of the cell so red blood cells can transport the gases throughout the body.

Lysosomes break down (digest) the harmful materials white blood cells engulf.

Can't get credit for just function of cell or organelle, must have both for point.

Misconception: Saying function of lysosome is to engulf or take in harmful materials or that white blood cells break down (digest) harmful materials.

23.

4

A.) LEAF Cell - the chloroplast is the part of the leaf cell that makes the food it is the green part. they use the light +  $\text{CO}_2$  +  $\text{H}_2\text{O}$  to form their energy for the whole plant.

B.) Skeletal Muscle Cell - the mitochondrion is what is what makes the muscle cell strong it makes all of the power + energy the cell needs to use. It is for all power. Mitochondrion are the power house of the muscle cell.

C. Red blood Cell - the cell membrane is what lets the waste, water,  $\text{CO}_2$  +  $\text{O}_2$  diffuse into the cell without the cell membrane we could not get  $\text{CO}_2$  +  $\text{O}_2$  into and out of the body.

D.) White Blood Cell - the lysosome is the part of the cell that kills all of the bad stuff. they are the contingency devise of the cell to kill the other bad ones.

A.) In a leaf cell the chloroplast helps in the process of photosynthesis which the plant makes oxygen out of carbon dioxide in.

B.) In a skeletal muscle cell the mitochondrion helps produce energy for the muscle to use in movement.

(i.) In a red blood cell the cell membrane is permeable which allows the cell to absorb oxygen from the lungs and bring it to different parts of the body.

D.) In a white blood cell the lysosome helps the cell in fighting foreign substances in the body.

23.

3

In a leaf cell, the chloroplast help use the energy absorbed from light to make ATP by using the Calvin Cycle.

In skeletal muscle cells, mitochondria help supply the energy needed for movement by running the Krebs Cycle, part of the Glucose cycle.

Cell membranes help red blood cells by screening what comes in or goes out. It can do this because it is a semi-permeable membrane.

Lysosomes are used in white blood cells to break down foreign materials that were found in the blood stream.

23.

3

a) In a leaf cell the chloroplast is used directly in photosynthesis. It is used to absorb the energy need in the dark phase.

b) Skeletal muscles move, and need energy. Mitochondria break down food, giving the muscle energy.

c) A red blood cell contains hemoglobin, which is used to carry oxygen. The membrane holds in the hemoglobin.

d) White blood cells fight diseases. Lysosomes are used to break down bacteria, or proteins from a virus.

23. a. A leaf cell is important in the development of chloroplast because it absorbs light which is stored as protein in the chloroplast for the process of photosynthesis which builds the leaf. 2
- b. A skeletal muscle cell is important for mitochondrion because it contains the mitochondrion which is able to synthesize protein and build the skeletal muscle.
- c. Red blood cell is aided by cell membrane because the cell membrane allows oxygen to pass through the cell and oxidize the blood.
- d. A white blood cell is aided by a lysosome because a lysosome attacks foreign molecules of bacteria with lysozyme and this helps the white blood cell fight diseases and infection.

23. a) a leaf cell contains chloroplast which is used in photosynthesis. It helps carry out the specific function of feeding it and the green color. b) Mitochondrion in a skeletal muscle cell help in the contracting and retracting of a muscle. c) Cell membrane on a red blood cell helps to protect the stuff inside the cell and helps it to keep a free flowing shape. d) Lysosome in a white blood cell help to kill and get rid of the bacteria which enters in through the cell membrane. 2

23.

1

a) In a leaf cell, the chloroplasts hold chlorophyll, a necessary substance in photosynthesis, the process of making glucose for energy in a plant.

b) The mitochondrion in a skeletal muscle cell gives the cell a firmness to it so it doesn't break.

c) The cell membrane of a red blood cell surrounds the cell and only lets in and out certain things. This helps against certain diseases.

d) The lysosome in a white blood cell produces the antibodies necessary for the body to fight off viruses.

23.

1

a. Chloroplast is a substance in a leaf cell that produces food from the sun by photosynthesis.

b.

c.

d.



24. a. Describe nuclear fission. Include an explanation of where the energy released comes from.
- b. Discuss **one** positive impact from its use.
- c. Discuss **one** negative impact from its use.

**CR#: 24**

**Learning Results: M-4**

Implications of Science and Technology

- M Students will understand the historical, social, economic, environmental, and ethical implications of science and technology. Students will be able to
- 4 analyze the impacts of various scientific and technological developments.

### CONSTRUCTED-RESPONSE SCORING GUIDE

Score	Description
4	Student demonstrates thorough ability to analyze the impacts of a scientific and technological development. Response describes nuclear fission, including an explanation of where the energy released comes from. Response also discusses one positive and one negative impact from the use of nuclear fission. Response contains no errors or omissions.
3	Student demonstrates general ability to analyze the impacts of a scientific and technological development. Response addresses most, if not all, parts of the item. Response contains minor errors or omissions.
2	Student demonstrates limited ability to analyze the impacts of a scientific and technological development. Response partially addresses the item. Response contains major errors or omissions.
1	Student demonstrates little ability to analyze the impact of a scientific and technological development. Response minimally addresses one part of the item.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

## Training Notes for Constructed-Response #24

- Part a. describe and explain (2 points)  
Nuclear fission is the splitting of an atom into smaller pieces.  
The energy comes from a loss in mass ( $E=mc^2$ ). If addressed, most students have the misconception that energy comes from breaking bonds.
- Part b. positive impacts (1 point)  
nuclear power plants for generating electricity  
A-bomb helped end World War II  
alternate fuel
- Part c. negative impacts (1 point)  
radioactive waste is around for a long time  
danger of nuclear reactors releasing radioactivity into the air  
A-bomb loss of human lives, suffering of survivors, and destruction of property  
Core meltdown – China syndrome

Nucleic bonds – no

If both parts b and c are too general – 1 point for both.

Breakdown  $\neq$  splitting

Radioactive decay is not fission

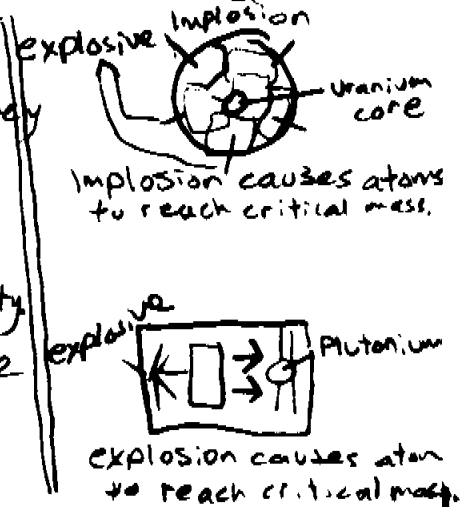
24.

4

\*Nuclear fission is the process of splitting an atom. There is what is called "critical mass" in an atom, and this can be reached in uranium or plutonium by 2 methods: Implosion, or merely side smashing the atoms. Once its mass is pressed hard enough, based on the equation  $E=mc^2$  this will turn a little bit of mass into a lot of energy. <sup>energy</sup> <sup>mass</sup> <sup>speed of light</sup>

b) One positive impact is that we now have a relatively cheap way to create a lot of energy. Now nuclear energy can heat water, this pressure can spin a turbine hooked to a generator to create electricity. - This is how a nuclear reactor currently in use would work. (in simple terms).

c) One negative impact is the great mass destruction that can be caused when this great change of mass to energy is not controlled or contained. Now the world is at threat of destruction by nuclear means - a very negative impact.



- a) Nuclear fission is when the nucleus of an atom <sup>EX:  ${}_{92}^{235}\text{U}$</sup>  is broken apart, releasing a tremendous amount of energy because  $E=mc^2$ . Energy = mass  $\times$  speed of light  $(3.0 \times 10^8 \text{ m})^2$ . Therefore, a large amount of energy can be released from a small amount of mass.
- b) Nuclear reactors <sup>/power plants</sup> use fission to generate energy to power the world.
- c) Nuclear fission has also been used as a weapon in war, ~~ex~~ Hiroshima, and has killed many people and caused catastrophic damage. Another negative impact is the leftover fallout and radioactive waste of fission reactions. For safety and environmental reasons, the waste must be stored and contained until it becomes less radioactive.

Nuclear fission is the high-energy splitting on the nucleus of an atom, typically Uranium. The forces holding the atom together split, and a conversion from matter to energy occurs, which produces a great deal of energy ( $E=mc^2$ ).

It provides an astonishing amount of energy. This is positive because all that is needed to power millions of people is a piece of uranium the size of a pencil eraser.

Unfortunately, uncontrolled nuclear reactions have been used in atomic bombs, and the energy released kills, maims, and wounds the innocent and dehumanizes conflict.

(a) Nuclear fission is when an atom splits. For some reason (either because of a natural breakdown or human induced) it breaks down and in doing so releases energy in the form of heat, light, etc. The energy is from an electron that breaks its bond with the nucleus of an atom. The energy comes from the bond. (b) Nuclear fission can be used to benefit humans. We use it to produce electricity at nuclear power plants. (c) However, nuclear fission has been used by humans to produce something very bad, very deadly, and very radioactive, the atomic bomb.

a. Nuclear Fission is the splitting of molecules. As the bonds are broken, energy is released.

b. The immense amount of energy can be used as an alternative to fossil fuel energy, which is harmful to the atmosphere.

c. Used improperly, or handled improperly, a nuclear disaster could be created. Killing thousands (see Chernobyl).

(A) Nuclear fission is the process by which a nuclear is blown and the radiation kills lots of stuff

(B) on positive impact of Nuclear fission it probably could solve some cases of cancer and other health problems people have

(C) on negative cause is that people, plants, and animals can die from the radiation.

24.

1

Nuclear Fission is when atoms join together. A positive impact would be the energy produced from the action of the atoms joining together. A bad thing about it is the toxic waste it produces

24.

1

a) cheap efficient power source  
b) nuclear waste and disposal

25. How many species of human beings are there today?
- A. 1
  - B. 3
  - C. 5
  - D. 7

**MC#:** 25

**Key:** A

**Learning Results:** A-2

Classifying Life Forms

- A Students will understand that there are similarities within the diversity of all living things. Students will be able to
- 2 describe similarities and differences among organisms within each level of the taxonomic system for classifying organisms (kingdom through species).



26. Bacteria are classified as prokaryotes. How are prokaryotes different from all other organisms?
- A. They consist of many cells.
  - B. They have cell walls.
  - C. They reproduce asexually.
  - D. They do not have nuclear membranes.

**MC#:** 26

**Key:** D

**Learning Results:** A-2

Classifying Life Forms

- A Students will understand that there are similarities within the diversity of all living things. Students will be able to
- 2 describe similarities and differences among organisms within each level of the taxonomic system for classifying organisms (kingdom through species).

27. Which is a function of the Golgi apparatus in a cell?

- A. breaking down food particles
- B. packaging and secreting products
- C. releasing energy
- D. making proteins

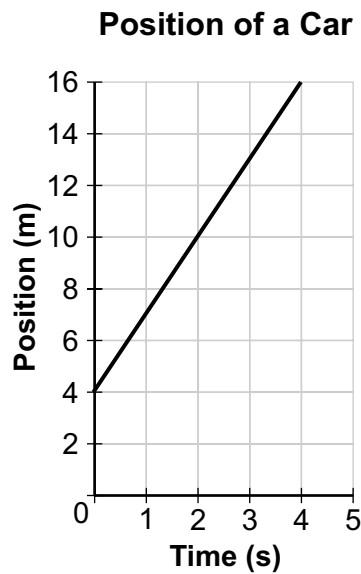
**MC#: 27**

**Key: B**

**Learning Results: C-1**

Cells

C Students will understand that cells are the basic units of life. Students will be able to  
1 relate the parts of a cell to its function.



28. This graph shows the position of a moving car with respect to a wall that is located at 0 m. The car's speed was
- A. 0.25 m/s.
  - B. 1.0 m/s.
  - C. 3.0 m/s.
  - D. 4.0 m/s.

**MC#:** 28

**Key:** C

**Learning Results:** L-4

Communication

- L Students will communicate effectively in the application of science and technology. Students will be able to  
4 employ graphs, tables, and maps in making arguments and drawing conclusions.

40. Describe **four** ways that the processes of photosynthesis and cellular respiration are alike.

**CR#: 40**

**Learning Results: B-2**

Ecology

- B Students will understand how living things depend on one another and on non-living aspects of the environment. Students will be able to
- 2 compare the processes of photosynthesis and respiration, and describe the factors that affect them.

### CONSTRUCTED-RESPONSE SCORING GUIDE

Score	Description
4	Student demonstrates thorough ability to compare photosynthesis and respiration. Response completely describes four ways that these processes are alike. Response contains no errors or omissions.
3	Student demonstrates general ability to compare photosynthesis and respiration. Response broadly describes ways that these processes are alike. Response contains minor errors or omissions.
2	Student demonstrates limited ability to compare photosynthesis and respiration. Response partially describes ways that these processes are alike. Response contains major errors or omissions.
1	Student demonstrates little ability to compare photosynthesis and respiration. Response minimally describes a way that these processes are alike.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

### Training Notes for Constructed-Response #40

In general, this item can be scored by assigning 1 point for each description of a way photosynthesis and cellular respiration are alike. However, scorers should always make sure the score arrived at by assigning points is aligned with the corresponding description in the rubric above. If it is not, the rubric has priority in assigning the final score.

1. naturally occur in living things, but not in nonliving things
2. involve the same molecules (i.e., carbon dioxide, water, sugar [glucose], oxygen)
3. catalyzed by enzymes
4. involve the transfer of energy
5. take place in cells or take place in specific parts of cells
6. both are chemical reactions
7. both can occur in light

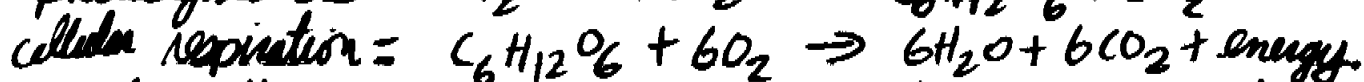
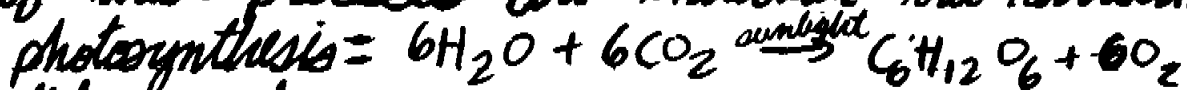
40.

4

Photosynthesis and cellular respiration are alike in a few ways. For example, both use the same basic ingredients:  $O_2$ ,  $CO_2$ ,  $H_2O$ , glucose, and ATP. Also both are essential to maintaining the life of the organism (plant or animal). Another way photosynthesis and cellular respiration are alike is that both can be performed in plants. One other way that photosynthesis and cellular respiration are alike is that they both have special organelles for the process. Photosynthesis uses chloroplasts and cellular respiration uses mitochondria. Both of these are double-membraned organelles with specific jobs.

Photosynthesis is the process that ~~chloroplasts~~ do by taking carbon dioxide, water and sunlight (attracted by chlorophyll), to make sugar and oxygen.

Cellular respiration is the process that mitochondria do by taking sugar and oxygen to make carbon dioxide, water, and energy. The equations of both of these processes are identical but reversed.



photosynthesis is the process of storing energy and cellular respiration is the process of using already stored energy. Both processes use enzymes to fulfill their tasks. Both processes are done by organelles.

(cellular respiration is done by mitochondria, and photosynthesis is done by chloroplasts.) All green leafy plants do both of these processes. All living organisms do cellular respiration or they will die.

40. Four ways that metabolic functions of photosynthesis and cellular respiration are alike are that they both use oxygen in some sort of a way. The cellular respiration takes in oxygen and the photosynthesis releases oxygen. They both use energy, the photosynthesis uses the light energy through the sun. The cellular respiration uses energy in the form of muscles. They both release a substance, photosynthesis releases oxygen and cellular respiration releases carbon dioxide. They both store what they have taken in, the cellular respiration stores the oxygen and the photosynthesis stores the light energy. 3

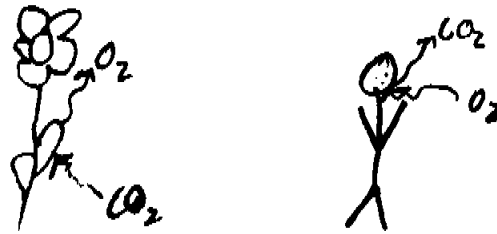
The metabolic functions of photosynthesis and cellular respiration have similarities. Four main pieces are needed to make each function successful. The first, some sort of energy source needs to be taken in, like the sun's rays or nutrients (example carbohydrates). The second, this energy is used to make something useful like glucose in plants and ATP, made by mitochondria, in cells. The third point is that this useful product restores energy and nutrients to other parts of the plant or cell. The fourth and final point is that these are both cycles. The more often they occur the more energy is produced, the more energy more seeds can be produced or mitosis can occur. Therefore, the more seeds the more plants, and more mitosis (cell division) more cells. The greater number of plants, the more oxygen is produced. And with more cells, more infections can be healed.



40.

2

One way they are alike, is that they are both necessary to sustain life in their respective organisms. Another is that they both require Oxygen;  $O_2$  for respiration and  $CO_2$  for photosynthesis. They are also both necessary for our metabolisms to work and produce energy. Respiration and photosynthesis both require the intake and expulsion of opposite gasses.



40.

2

Photosynthesis is changing light energy into "food" for green plants. In other words, the sunlight is taken in by the plant and stored to be used later. Cellular respiration takes that stored food and converts it back into energy for the plant to actually use. So, many of the steps of both photosynthesis and cellular respiration are very similar. One, energy begins the photosynthesis reaction and energy is the result of cellular respiration. Similarly, sugar ends photosynthesis and begins cellular respiration. Both occur in green, chlorophyll containing plants.

Four ways that the metabolic functions of photosynthesis and cellular respiration are alike are They both have to do with plants They both need sunlight. They both help things breathe. And it helps them to grow and reproduce.

Both photosynthesis and cellular respiration provide oxygen, food, and both keep us alive. They both take in carbon dioxide and change it into a form that can be used by all living things. This form is oxygen. Without it we would all die, and this allows us to breathe and live on.

41. A high school science textbook published in 1987 defined quasars as “galaxies that emit radio waves.” Imagine that you are interested in learning more about what causes quasars and especially in obtaining more up-to-date information about quasars. Describe **four** different sources of information you could consult. At least two sources you describe should provide more up-to-date information than the textbook.

**CR#: 41**

**Learning Results: G-2**

The Universe

- G Students will gain knowledge about the universe and how humans have learned about it and about the principles upon which it operates. Students will be able to
- 2 research current explanations for phenomena such as black holes and quasars.

### CONSTRUCTED-RESPONSE SCORING GUIDE

Score	Description
4	Student demonstrates thorough ability to locate sources of information on astronomical phenomena. Response completely describes four sources of information about quasars, with at least two of the sources providing more up-to-date information than the textbook. Response contains no errors or omissions.
3	Student demonstrates a general ability to locate sources of information on astronomical phenomena. Response broadly describes at least three sources of information about quasars, with at least one of the sources providing more up-to-date information than the textbook. Response contains minor errors or omissions.
2	Student demonstrates a rudimentary ability to locate sources of information on astronomical phenomena. Response partially describes two sources of information about quasars <b>or</b> simply lists three or four sources of information about quasars. Response contains major errors or omissions.
1	Student demonstrates an inadequate ability to locate sources of information on astronomical phenomena. Response minimally describes one source of information about quasars <b>or</b> simply lists two sources of information about quasars.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

## **Training Notes for Constructed-Response #41**

encyclopedias (CD and regular only count once)

astronomy books (on quasars) from home, school, and public libraries

\*popular astronomy magazines

\*scientific journals describing recent research

\*Internet sites such as NASA

planetarium and the people who work there

high school science teachers

\*college professors and astronomers who are doing research in the area

\*indicates sources that could provide more up-to-date information than the textbook

Note: Do not count dictionaries or newspapers.

41.

4

The first source would be the basic encyclopedia, preferably the edition from the current year. The encyclopedia will provide a very basic and watered down version. The second source which would provide probably the most current information would be the Internet, you can find sources about everything. A third source would be a magazine/newspaper article dealing with the subject, this will provide info about how scientists are researching this topic. Finally, contact a scientist, use a human resource. They will be able to inform you of very up-to-date dealings with quasars.

41.

4

Four sources of information for quasars could be a cosmologist, the internet, a modern encyclopedia and a book written specifically on quasars. A cosmologist, or someone who studies the cosmos, would have up-to-date information at her/his disposal and would even be able to discuss any questions or ideas prompted by further information. The internet, if proper searching techniques are used, can offer a wealth of information on any subject. There may even be excellent diagrams or pictures to illustrate ideas presented. Encyclopedias usually contain basic information, but it would provide important key words for further study. A book written and published on quasars would be an excellent source, since it would mean someone did research to write the book.

41.

3

one source I could use is the internet. There are probably hundreds of sites on the internet that could help me, and one could be the NASA homepage, which is probably updated often. Another source could be an encyclopedia. It would depend on when it was published as to if it is up-to-date or not, but you could probably find info in that. Another source could be to ask someone, such as a science teacher. That would be up-to-date. And another way is you could go to the library and find a book on quasars, and read that. Make sure it is updated, and that can be your 4th source.

41. There are many places that one could look to find information on a certain subject. To find up-to-date info. on quasars, one place to look would be on the Internet. The Internet gives fast, easy to read, and up-to-date information on just about anything. It's also easy to access.

3

Another place would be in a library. If you use the equipment they offer there you can find many books on science that may or may not be newer.

An encyclopedia is an excellent place to look because they have to be kept up-to-date since they carry info on practically everything that the world knows about.

The last place to look would be in your own science textbook. More often than not they are renewed every few years making the editions newer and more up-to-date.

- a.) A science journal would give any current or new findings about quasars.
- b.) The internet has thousands of websites; there would be up to date information about quasars.
- c.) Contacting NASA and asking for information about quasars could be productive.
- d.) A college/university that has an astronomy program could provide up-to-date information on quasars.

- You could look in a more recent text book.
- look up quasars in a dictionary
- You could also look on the internet.
- In an encyclopedia.
- Science and Technology magazine.

41.

1

- ① The Internet, look up Quasars
- ② Book about Astrology
- ③ Spins: a CD Rom like an encyclopedia.

41.

1

A library, an encyclopedia, New Science  
book.